# The Mixed Ligand Approach to the Preparation of Low-Dimensional Cluster Materials

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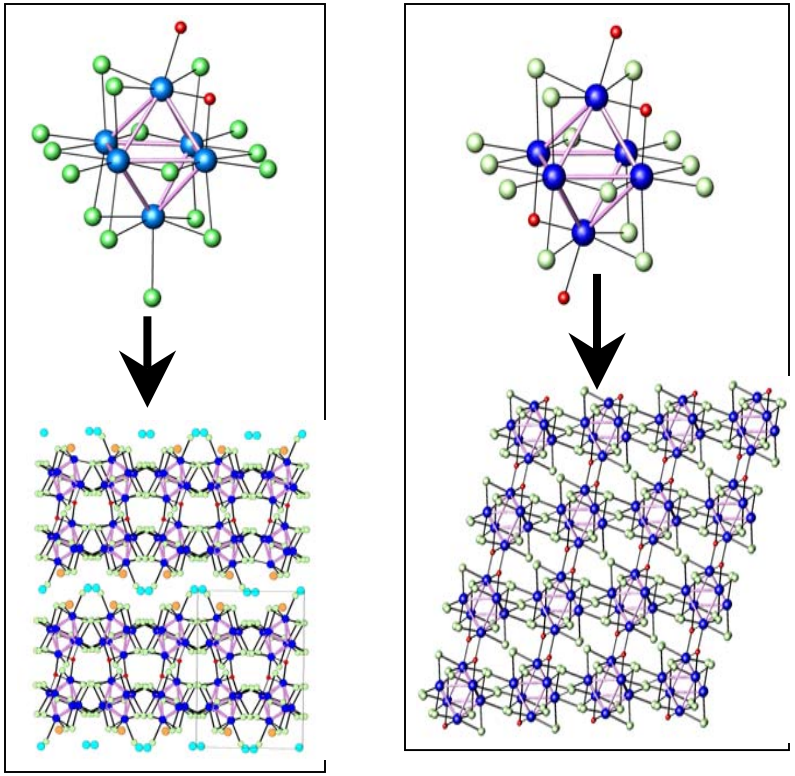
The major advances in developing strategies for rational design and preparation of materials for specific application are associated with the use of building blocks with well-defined directional bonding preferences. In metal-cluster chemistry, the ability to control the framework dimensionality is one of the utmost goals and challenges in the development of cluster-based materials. Inspired by the remarkable physical properties and applications of cluster-based materials, such as superconductivity, fast ionic conductivity, thermoelectric properties, and catalytic activity, we are interested in develop a novel approach to the preparation of low-dimensional materials based on octahedral metal clusters.



Changing the number and arrangement of oxygen ligands (red) leads to a change from a layered structure on the left ($Cs_2InNb_6Cl_{15}O$) to a three-dimensional structure on the right $A_xNb_6Cl_{12}O_2$

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**Knowledge dissemination, contribution to training and education, and collaborations**

- Publication of nineteen papers
- Publication of a Ph. D. thesis
- Five undergraduates (Michael Essig, Greg Becht, Maria Gentilliti, Sana Ashraf, and Yumi Okuyama); four graduate students (Katya Anokhina, Yan Zhihua, Andrew Zhou, and Kevin Zhao), and three postdocs (T. Duraisammy, C. Amburose, and Michael Bangbo) contributed to this work. Katya Anokhina received her Ph.D. in 2001 and is presently a postdoc with Prof. A. Jacobson at the university of Houston. Duraisammy is now working as Research Associate at the University of Iowa, and C. Amburose has joined the National University of Singapore.

**Outreach:**

- Three highschool students: Ondra Walker and Monique Williams funded by the project SEED administered by the ACS) and one Hispanic high school student (Lucy Bonilla) were involved in this project.
- Active Participation in the NSF-funded program Scimax, which brings middle and high school students and teachers to the department for a total of four weeks in the summer to help develop research-based science curriculum for K-12
- Active participation in the “Teacher Link Program” funded by NSF and organized by the North Carolina Science, Mathematics, and Technology Education Center.